Associations between Chronic Conditions and Medical Errors in U.S. Pediatric Trauma Patients

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Abstract

Background: There is a scarcity of literature on medical errors (MEs) in children with chronic conditions who have sustained traumatic injury, even though the prevalence of preexisting conditions has been increasing in the pediatric population.

Methods: We used the 2009 Kid's Inpatient Database, a nationally representative dataset of pediatric discharges, to examine 2561 cases of MEs out of 98,439 trauma patients. MEs were identified by the International Classification of Diseases, Ninth Revisions, Clinical Modification (ICD-9-CM) diagnosis codes. The ME rates per 100 discharges were calculated and compared among inpatients with and without preexisting chronic conditions. Adjusted odds ratios (AORs) and 95% confidence intervals were calculated using logistic regression models with ME as the response variable and patient and hospital characteristics as independent variables.

Results: Pediatric trauma patients with chronic conditions experienced a higher ME rate compared to patients without chronic conditions [4.04 (3.75-4.33) versus 1.07 (0.98-1.16) per 100 discharges]. The rate of MEs increased with increasing numbers of chronic conditions. After controlling potential confounding factors, the odds of ME increased by 39% if one chronic condition existed (AOR: 1.39, 95%CI: 1.23-1.58), and by 77% if more than one chronic condition existed (AOR: 1.77, 95%CI: 1.55-2.03). Increased length of stay, age, and gender also showed significant associations with elevated MEs.

Conclusions: The presence of chronic conditions more than tripled the likelihood of MEs in pediatric trauma patients. Future research should examine the most common types of chronic conditions and MEs in this patient group for strategies to improve patient care.

Background

A medical error (ME) occurs when a health-care provider chooses an inappropriate method of care or when iatrogenic complications occur.[1] A 2000 Institute of Medicine report indicated that MEs are estimated to result in 44,000 and 98,000 preventable deaths and 1,000,000 excess injuries each year in U.S. hospitals,[2] making MEs the sixth to ninth leading cause of death.[3] MEs, though also common in adults, can have more serious consequences in children.

Traumatic injuries are the leading cause of death among children, and can have lasting impacts on children of all ages.[4] Many studies have reported that there has been a dramatic increase in the number of children with chronic health conditions in the U.S. (a health condition that lasts ≥ 12 months or at time of diagnosis is likely to have a duration of ≥ 12 months).[5] A recent study estimates that 43% of U.S. children (32 million) currently have at least 1 of 20 chronic health conditions assessed, increasing to 54.1% when overweight, obese, or at risk for developmental delays. With the proportion of children with chronic conditions increasing, it is not surprising to find more pediatric trauma patients with chronic conditions treated in hospitals.

Pre-existing chronic conditions increase the complexity of medical care of pediatric patients. Our previous study showed that chronic conditions can significantly increase the incidence of MEs among pediatric inpatients, with 5.3 MEs per 100 discharge in children with chronic conditions and 1.3 per 100 discharges among children without chronic conditions.[6] On the other hand, the effect of chronic conditions on MEs in pediatric trauma patients has not been reported. It is important to examine the associations between chronic condition and MEs among pediatric trauma patients because this subset of patients may be more likely to experience medical errors,

require additional care, and have worse outcomes compared to pediatric trauma patients without chronic conditions.[7, 8]

The objectives of this study were to compare the rates of MEs among pediatric trauma patients with and without chronic conditions and to explore potential risk factors for MEs in these patients. Understanding the relationship between chronic conditions and MEs among pediatric trauma patients can help determine whether this subset of patients is a special risk group and therefore need to be treated differently to reduce the risk of MEs.

Methods

Data Source

This study used the Kids' Inpatient Database (KID) 2009. Sponsored by the Agency for Healthcare Research and Quality (AHRQ), the KID is a national dataset that is a part of the Healthcare Cost and Utilization Project (HCUP). It examines U.S. children's usage of hospital services, outcomes, and financial information. Containing more than 100 clinical and non-clinical variables, the KID has a sample of pediatric discharges from all community, non-rehabilitation hospitals in states that have agreed to participate in the HCUP.

At the time this study was performed, the 2009 KID was the most recently available dataset and includes 3.4 million pediatric discharges out of a total of more than 7.3 million hospitalization records nationwide from 4,121 hospitals in 44 states. Included as stratification variables are hospital geographic region (Northeast, Midwest, West, and South), hospital control (public, voluntary, and proprietary), hospital location (urban or rural), hospital teaching status (teaching or non-teaching), hospital bed size (small, medium, and large), and hospital type (children hospital, non-children hospital, and children's unit in general hospital).

Definition of Pediatric Discharges and Trauma

The definition of pediatric discharges in the 2009 KID is all discharges of patients 20 years of age or younger at the time of admission. We used the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) principal diagnosis codes to determine whether or not the patient was a trauma patient. Using the National Trauma Data Standard Patient Inclusion Criteria, a trauma patient was defined as one who sustained a traumatic injury and fit under ICD-9-CM codes 800-959, excluding late effects injury (905-909), superficial injuries (910-924), and foreign bodies (930-939).[9]

Definition of Chronic Conditions

A chronic condition in KID was defined as a condition that lasted 12 months or longer and that met one or both of the following conditions: 1) the condition limited self-care, independent living, and social interactions, or 2) the condition caused individuals to require continuous intervention with medical products, services, and special equipment. The identification of chronic conditions is based on ICD-9-CM diagnosis codes. In addition to the principal diagnosis code, the 2009 KID provides up to 24 secondary ICD-9-CM codes for each patient. A "Chronic Condition Indicator" was provided to categorize each specific ICD-9-CM diagnosis code into chronic condition or not chronic condition. For our trauma patients, we searched all secondary codes to determine whether or not the patient had a chronic condition and counted the number of chronic conditions.

Definition of Medical Errors

Employing the approach of similar studies by Slonim and by Ahuja on medical errors in pediatric patients,[6, 7] MEs were identified using several specific ICD-9-CM codes for iatrogenic MEs. Our study included ICD-9-CM codes 996-999 (complications of surgical and medical care) and code 995.2 (unspecified adverse effect of drug medicinal and biological substance). For each KID discharge, we searched through all 24 secondary diagnosis codes. A hospital-reported ME was defined as any discharge that had at least one of the ICD-9-CM codes mentioned previously. These MEs were considered iatrogenic medical injuries.

Determination of Injury Severity

We used the New Injury Severity Score (NISS) to measure severity of injuries. Assigned by a publicly available Strata program provided by the ICD Programs for Injury Categorization (ICDPIC), the NISS has been shown to be more predictive of outcomes than the Injury Severity Score, particularly for moderate to severe injuries.[10] The ICDPIC uses ICD-9-CM codes to assign a severity score ranging from 1 to 75, with 75 being the most severe. The NISS is computed as a sum of the squares of the three most severe injuries.

Statistical Analyses

We used SAS 9.3 (SAS Institute, Cary, NC) to account for the multi-stage sampling of the 2009 KID dataset. The data were weighted and adjusted accordingly to represent all pediatric trauma hospitalizations in the U.S. based on information provided by the 2009 KID. The following variables were included as covariates: socio-demographic information (age, gender, race, residence type, and household income), injury severity score, hospital stay characteristics

(length of stay, discharge status, and injury intent), hospital characteristics (size, region, location, teaching status, and type), and health insurance (public, private, and self-pay).

The rates of MEs per 100 pediatric trauma discharges were calculated for patients with and those without chronic conditions by patients' demographics, characteristics of injuries and hospitals. The 95% confidence intervals (95% CI) for the ME rates were compared between pediatric patients with and without chronic conditions to see whether the difference between the two groups was statistically significant. Odds ratios and 95% confidence intervals were calculated by fitting univariate and multivariable logistic regression models with ME as the response variable and length of stay (LOS), number of chronic conditions, age group, gender, race, NISS, hospital type, and health insurance coverage status as independent variables. The rate of ME per 100 discharges and the rate of ME per 1000 hospital days were plotted against the total number of chronic conditions associated with each discharge record. The rate of ME per 1000 hospital days takes patients' exposure time at hospital into consideration.

Results

Out of a total of 3.41 million patients in the 2009 KID, 123,565 trauma patients were identified. There were a total of 2,561 cases of MEs reported (Table I). Of these, 1676 (65.4%) were MEs among patients who also had preexisting medical conditions, representing a national estimate of 2,449 pediatric trauma patients with chronic conditions who experienced MEs. Overall, pediatric trauma patients with chronic conditions had a higher rate of MEs than those without chronic conditions (4.04 per 100 discharges versus 1.07 per 100 discharges) (Table I). For almost all of the variables examined, patients with chronic conditions were two to three

times more likely to have MEs compared to their counterparts without chronic conditions (Table II).

Regardless of the presence of preexisting conditions, male pediatric trauma inpatients and those over age 13 were more likely to experience MEs (Table II). The presence of chronic conditions nearly tripled patients' likelihood for experiencing MEs. The rate of MEs was also higher among patients with chronic conditions who had public insurance.

The rate of MEs was highest among patients with a moderately high injury severity score of 25 to 34 for both patients with chronic conditions and without chronic conditions (Table III). Patients with chronic conditions who had MEs were more likely to have longer LOS than patients without chronic conditions. For those with a LOS ≥15 days, the rate of MEs was 24.92 per 100 discharges for patients with chronic conditions.

Regardless of the presence of chronic conditions, the ME rate was highest for those patients in a "children's unit in a general hospital" compared to other hospital types (Table IV). Patients with chronic conditions in hospitals with large bed size also had a higher rate of MEs. Teaching hospitals reported a higher rate of MEs than non-teaching hospitals, and patients with chronic conditions were over 4 times more likely to experience MEs in teaching hospitals compared to patients without chronic conditions.

The number of chronic conditions, age, gender, race, intention, LOS, hospital location and hospital region remained significant in the multivariable model (Table V). The odds of experiencing MEs also significantly increased with increasing numbers of chronic conditions. In the multivariable model, the greatest adjusted OR of ME among age groups was for 13-18 year olds. Male patients, African Americans, patients from non-urban areas, hospitals in rural areas or

hospitals in west regions, and patients with intentional injuries were significantly more likely to experience medical errors. In addition, the association between MEs and LOS was the strongest factor even after controlling for confounding variables, with a stay of 15+ days having AOR=70.32 (95% CI: 58.02-85.23).

The rate of MEs increased with increasing number of chronic conditions in 2009 KID trauma patients (Figure 1). The rates of MEs per 100 discharges and per 1000 hospital days were highest for patients with five or more chronic conditions. ME rates per 1000 hospital stay days tended to be higher than ME rates per 100 discharges except for patients with more than four chronic conditions. While the rate per 1000 hospital days remained fairly constant with more than two chronic conditions, the rate per 100 discharges continued to increase steadily with up to five or more chronic conditions.

Discussion

Previous studies in general pediatric populations have confirmed that children with chronic conditions are at an increased risk for MEs.[11, 12] Our study supports this finding, and shows that overall, pediatric trauma patients with chronic conditions were more than three times more likely to experience MEs than their counterparts without chronic conditions. Moreover, we found that the rate of MEs per 100 discharges and the incidence rate per 1000 hospital days increased with increasing numbers of chronic conditions. This association remained statistically significant in the multivariable model that controlled for the confounding effects of other risk factors. Considering only the ME rates per 100 discharges, increasing numbers of chronic conditions appear to be a predictor for steadily increasing numbers of MEs. However, the trend for the

number of MEs per 1000 hospital days seems to indicate that the average number of MEs remains fairly constant with the presence of more than two chronic conditions.

In previous studies, MEs and LOS have each been shown to be significantly associated with the presence of chronic conditions.[5, 11-13] The combination of all three factors could explain why our results showed that the association between MEs and LOS is significantly magnified in pediatric trauma patients with chronic conditions compared to their counterparts without chronic conditions. It is not possible to determine the direction of causality between MEs and LOS retrospectively using the KID. However, the higher degree of care required by patients with preexisting conditions and their increased propensity for encountering MEs due to their more complex conditions could contribute to the difference seen in LOS between patients with and without chronic conditions.[8]

Past studies on ME frequency and age have yielded conflicting results. A small-scale study in a university hospital intensive care unit found no associations between age and MEs,[14] while a large-scale study using four years of HCUP data found that children between 6 and 12 years of age were most likely to experience MEs.[7] Our results more closely matched those of another general pediatric study that showed that children aged 15 to 18 were most likely to experience MEs.[15] These disparities could be attributed to the differences in study methods and definitions. Although we utilized methods similar to Slonim and colleagues,[7] their study examined data from more than two decades ago spanning several years. In addition, our study specialized in pediatric trauma patients, identifying them through the principal diagnosis code, while the study by Slonim and colleagues considered the broader pediatric inpatient population.

Consistent with past studies,[7, 15] our study also found that male patients were at significantly higher odds of experiencing MEs compared to their female counterparts, even when controlling for confounding factors. There are conflicting findings about the relationship between gender and mortality in trauma patients. Analysis from a past study showed that male gender is significantly related to lower survival among trauma patients, while a separate study found that gender does not affect trauma mortality.[16, 17] Despite the discrepancies between studies, it has been shown that immune responses to trauma are gender dimorphic and that sex steroids have a great influence over maintenance of immune functions following injury.[18] Future research should target male pediatric trauma patients because although there are inconsistencies across studies with respect to gender and mortality, male trauma patients nevertheless appear to be a higher risk patient group for medical errors compared to their female counterparts.

Study Limitations

Voluntary reporting of MEs by healthcare professionals detects only a small portion of MEs in hospitals. In pediatric patients, MEs are significantly underreported, particularly by physicians.[19] Other limitations are associated with the codes used to identify chronic conditions and MEs. First, preexisting conditions have a range of severity and chronicity, and coding often does not capture these characteristics. Despite this caveat, the use of diagnosis codes to identify pediatric patients with chronic conditions has become a widely accepted approach.[5] Second, ICD-9-CM codes may substantially underestimate the problem of MEs because coding can vary depending on the coder. At present, however, ICD-9-CM codes are the best available tool for examining MEs in large administrative databases,[15] and this is the first study to show significant associations between MEs and chronic conditions in pediatric trauma patients using a national database.

Conclusions

Our results show that the presence of chronic conditions more than tripled the likelihood of MEs among pediatric trauma patients with chronic conditions compared to their counterparts without chronic conditions. LOS was significantly increased in patients with chronic conditions compared to patients without chronic conditions. Our study also found that trauma patients 13-18 years of age were more likely to experience MEs; male gender was also positively associated with MEs. Future research should examine the types of chronic conditions and medical errors in pediatric trauma patients for improvement of strategies in patient care.

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Table I. Types of medical errors in U.S. pediatric trauma patients with and without chronic conditions, KID 2009

		With Chronic Conditions				Without Chronic Conditions			
		N of MEs	National estimate	Rate*	95% CI	N of MEs	National estimate	Rate*	95% CI
All inpatients discharge with medical complications		1676	2449	4.04	(3.75-4.33)	885	1284	1.07	(0.98-1.16)
996	Complications peculiar to certain specified procedures	366	535	0.88	(0.77-0.99)	179	261	0.22	(0.18-0.26)
997	Complications affecting specified body system	811	1181	1.95	(1.75-2.15)	341	495	0.41	(0.36-0.47)
998	Other complications of procedures not elsewhere classified	560	821	1.35	(1.22-1.49)	354	513	0.43	(0.38-0.48)
999	Complications of medical care not elsewhere classified	137	200	0.33	(0.27-0.39)	61	87	0.07	(0.05-0.09)
995.2	Unspecified adverse effect of drug medicinal and biological substance	7	11	0.02	(0.00-0.03)	7	11	0.01	(0.00-0.02)

* Rate: Number of medical errors per 100 discharges

Table II. Demographics and medical error rate in U.S. pediatric trauma patients with and without chronic conditions, KID 2009

	With Chronic Conditions				Without Chronic Conditions			
	N of MEs	National estimate*	Rate†	95% CI	N of MEs	National estimate*	Rate†	95% CI
Total	1676	2449	4.04	(3.78-4.37)	885	1284	1.07	(0.98-1.16)
Age group (years)								
0-5	204	306	3.64	(3.07-4.20)	144	212	0.64	(0.52-0.76)
6-12	206	310	3.11	(2.64-3.58)	142	211	0.70	(0.59-0.82)
13-18	748	1086	4.26	(3.88-4.63)	397	572	1.42	(1.26-1.57)
19-20	518	747	4.44	(3.99-4.89)	202	290	1.80	(1.52-2.08)
Gender								
Male	1256	1830	4.21	(3.89-4.53)	654	947	1.21	(1.10-1.32)
Female	420	619	3.69	(3.26-3.11)	229	334	0.90	(0.78-1.03)
Race								
White	732	1072	3.65	(3.29-4.01)	375	542	1.00	(0.89-1.11)
Black	336	492	5.03	(4.43-5.64)	164	239	1.49	(0.86-2.14)
Hispanic	260	373	4.31	(3.66-4.96)	152	216	1.09	(0.91-1.27)
Other‡	348	512	3.97	(3.40-4.53)	194	286	0.97	(0.81-1.13)
Medium household Income€								
Low income	568	833	4.47	(4.01-4.93)	279	408	1.18	(1.02-1.34)
Not low income	1054	1538	3.81	(3.50-4.13)	573	829	1.01	(0.92-1.11)
Missing	54	78	4.53	(3.25-5.81)	33	47	1.50	(0.86-2.14)
Patients residence								
Large metropolitan area	875	1271	4.00	(3.65-4.35)	440	629	0.97	(0.85-1.09)
Small metropolitan area	452	666	3.98	(3.54-4.42)	247	361	1.14	(1.00-1.29)
Micropolitan area	170	251	3.99	(3.33-4.65)	86	129	1.09	(0.86-1.31)
Non-urban area	124	185	4.26	(3.48-5.03)	77	115	1.40	(1.08-1.72)
Missing	55	77	4.88	(3.49-6.27)	35	50	1.58	(0.97-2.20)
Insurance								
Public	657	963	4.70	(4.21-5.18)	313	456	1.12	(0.98-1.27)
Private	749	1094	3.76	(3.44-4.09)	413	599	0.97	(0.87-1.07)
Self-pay	128	185	2.93	(2.38-3.47)	79	114	1.19	(0.92-1.46)
Other§	142	207	4.31	(3.63-4.99)	80	115	1.51	(1.16-1.85)

* National estimates were calculated using weights provided by the 2009 KID

† Rate: Number of medical errors per 100 discharges

‡ Includes cases with missing information

§ Includes cases with no charge and missing information

€ Median household income for patient's ZIP Code (based on current year): low income:0-25th percentile; not low income:26-100th percentile

Table III. Characteristics of hospital stay and medical error rate in U.S. pediatric trauma patients with and without chronic conditions, KID 2009

	With Chronic Conditions				Without Chronic Conditions			
	N of MEs	National estimate*	Rate†	95% CI	N of MEs	National estimate*	Rate†	95% CI
Intent								
Unintentional	984	1438	3.21	(2.93-3.49)	548	797	0.80	(0.72-0.89)
Intentional‡	299	428	4.65	(4.07-5.23)	142	203	2.23	(1.78-2.68)
Other§	393	583	8.73	(7.43-10.03)	195	285	2.49	(1.99-2.99)
Injury Severity Score								
1-8	255	375	1.57	(1.35-1.79)	260	381	0.60	(0.52-0.68)
9-15	350	514	3.00	(2.67-3.32)	218	317	1.03	(0.89-1.17)
16-24	430	628	6.22	(5.58-6.86)	168	241	2.13	(1.79-2.47)
25-34	405	590	11.27	(9.96-12.57)	124	180	4.89	(3.94-5.85)
35+	226	327	8.25	(6.72-9.77)	103	148	1.53	(1.06-2.01)
Discharge status								
Lived	1625	2375	4.04	(3.74-4.34)	873	1267	1.06	(0.97-1.15)
Deceased	50	73	3.94	(2.88-5.00)	10	14	3.97	(1.53-6.40)
Length of stay (days)								
0-2	131	194	0.64	(0.52-0.76)	139	204	0.25	(0.21-0.29)
3-7	316	461	2.37	(2.10-2.65)	285	415	1.36	(1.19-1.54)
8-14	340	494	8.52	(7.59-9.46)	223	321	6.36	(5.43-7.49)
15+	888	1298	24.92	(22.84-26.99)	238	344	17.14	(14.88-19.39)
Total charge€								
< 12219	69	101	0.78	(0.58-0.98)	58	86	0.21	(0.15-0.28)
12219-21925	53	78	0.64	(0.46-0.81)	63	93	0.29	(0.21-0.36)
21925-41045	152	224	1.55	(1.29-1.81)	179	261	0.97	(0.82-1.12)
> 41045	1402	2046	9.66	(8.92-10.41)	585	844	4.35	(3.87-4.84)

* National estimates were calculated using weights provided by the 2009 KID

† Rate: Number of medical errors per 100 discharges

‡ Includes cases that were coded as self-inflicted and assault

§ Includes cases with undetermined causes and missing information

€ cut points based on the 25th, 50th,and 75th percentiles of total charge of all patients

Table IV. Hospital characteristics and medical error rate in U.S. pediatric trauma patients with and without chronic conditions, KID 2009

	With Chronic Conditions				Without Chronic Conditions			
	N of MEs	National estimate*	Rate†	95% CI	N of MEs	National estimate*	Rate†	95% CI
Hospital type								
Not identified as children's hospital	707	1006	4.58	(4.03-5.13)	562	797	1.19	(1.07-1.32)
Identified as children's hospital‡	91	147	4.66	(3.12-6.20)	95	153	0.81	(0.62-1.00)
Children's unit in a general hospital	474	692	5.65	(5.03-6.28)	346	501	1.31	(1.12-1.50)
Missing	181	276	6.14	(4.98-7.31)	105	162	1.12	(0.85-1.40)
Hospital bed size								
Small	63	98	3.95	(2.44-5.45)	57	88	0.84	(0.61-1.06)
Medium	245	365	4.79	(3.98-5.61)	195	292	1.03	(0.82-1.23)
Large	998	1434	5.05	(4.57-5.53)	775	1109	1.25	(1.13-1.36)
Missing	147	223	6.64	(5.43-7.86)	81	124	1.17	(0.84-1.50)
Hospital location								
Rural	37	56	3.09	(2.04-4.15)	61	92	1.12	(0.83-1.41)
Urban	1269	1841	5.02	(4.60-5.44)	966	1396	1.17	(1.07-1.27)
Missing	147	223	6.64	(5.43-7.86)	81	124	1.17	(0.94-1.50)
Hospital region								
Northeast	196	262	3.55	(2.85-4.26)	224	306	1.13	(0.94-1.32)
Midwest	291	426	4.84	(4.14-5.54)	221	325	1.21	(1.04-1.37)
South	570	882	5.66	(5.00-6.32)	372	575	1.20	(1.01-1.38)
West	396	550	5.45	(4.60-6.30)	291	407	1.12	(0.97-1.28)
Hospital teaching status								
Non-teaching	230	329	3.61	(2.90-4.32)	222	318	0.94	(0.81-1.08)
Teaching	1076	1568	5.34	(4.86-5.81)	805	1171	1.25	(1.13-1.36)
Missing	147	223	6.64	(5.43-7.86)	81	124	1.17	(0.84-1.50)

* National estimates were calculated using weights provided by the 2009 KID

† Rate: Number of medical errors per 100 discharges

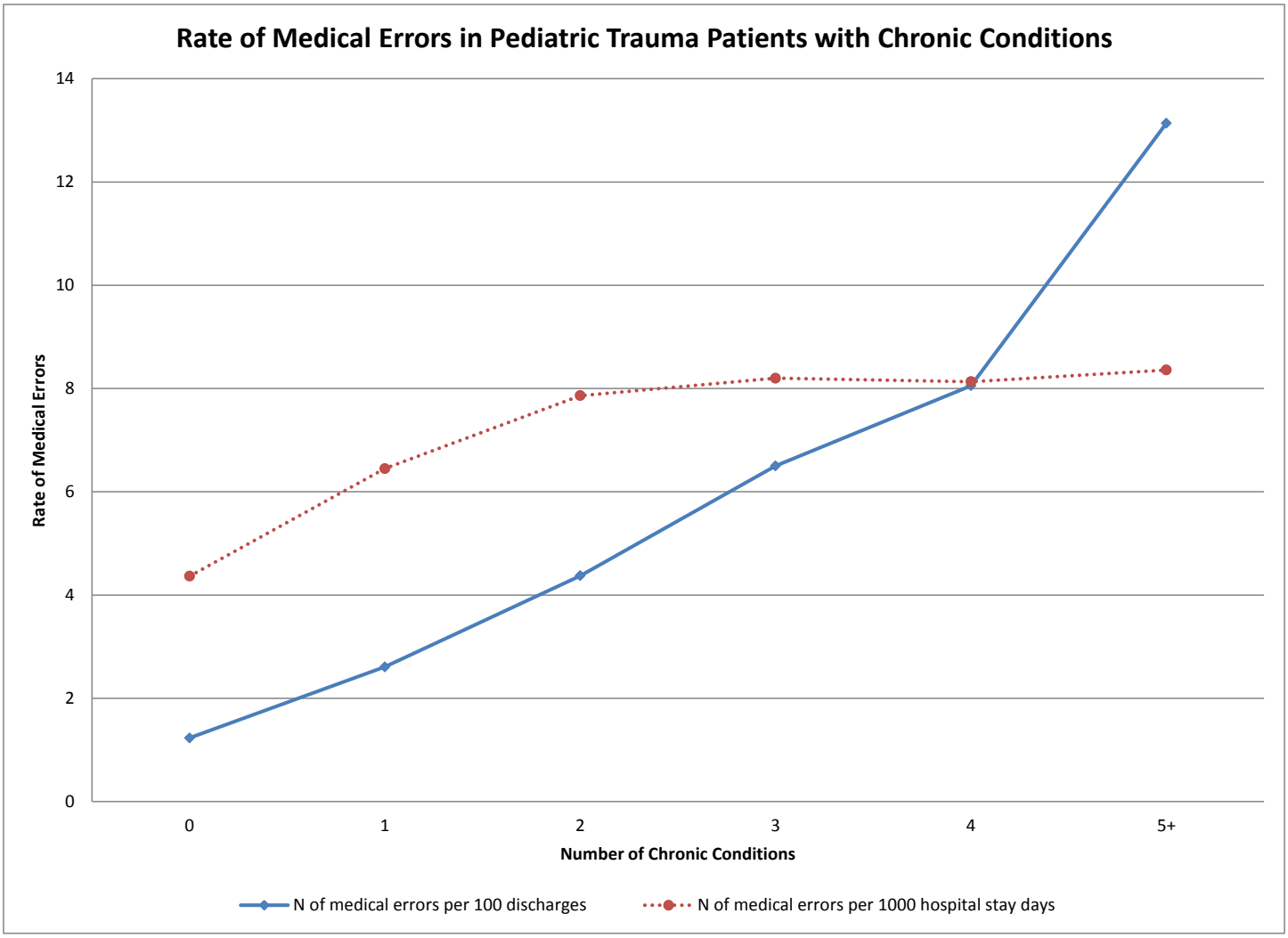
‡ Includes hospitals identified as children's general hospital and children's special hospital

Table V. Univariate and multivariate models of medical errors and selected discharge characteristics

	Univariate Model		Multivariate Model	
	AOR	**95% CI**	**AOR**	**95% CI**
N of chronic conditions				
0 (Ref*)	1.00		1.00	
1	2.38	(2.13-2.66)	1.39	(1.23-1.58)
2+	6.09	(5.44-6.82)	1.77	(1.55-2.03)
Age group (years)				
0-5 (Ref)	1.00		1.00	
6-12	1.05	(0.90-1.21)	1.25	(1.05-1.47)
13-18	2.04	(1.78-2.34)	1.32	(1.32-1.80)
19-20	2.57	(2.22-2.98)	1.26	(1.21-1.70)
Gender				
Female (Ref)	1.00		1.00	
Male	1.29	(1.17-1.42)	1.26	(1.13-1.39)
Race				
White (Ref)	1.00		1.00	
Black	1.48	(1.30-1.70)	1.23	(1.06-1.44)
Hispanic	1.07	(0.93-1.24)	1.12	(0.96-1.31)
Others	0.98	(0.83-1.15)	1.13	(0.98-1.32)
Intent				
Unintentional (Ref)	1.00		1.00	
Intentional	2.26	(1.99-2.57)	1.55	(1.34-1.78)
Other	3.18	(2.69-3.77)	2.60	(2.24-3.03)
Length of stay (days)				
0-2 (Ref)	1.00		1.00	
3-7	5.03	(4.32-5.86)	4.75	(4.01-5.63)
8-14	22.85	(19.49-26.80)	20.15	(16.62-24.43)
15+	82.83	(70.87-96.80)	70.32	(58.02-85.23)
Injury severity score				
1-8 (Ref)	1.00		1.00	
9-15	2.02	(1.79-2.29)	0.95	(0.83-1.08)
16-24	4.86	(4.29-5.51)	0.99	(1.85-1.10)
25-34	10.86	(9.32-12.65)	1.01	(0.83-1.21)
35+	4.15	(3.36-5.13)	1.01	(0.83-1.21)
Hospital location				
Urban (Ref)	1.00		1.00	
Rural	0.71	(0.57-0.88)	1.44	(1.12-1.86)
Hospital region				
Northeast (Ref)	1.00		1.00	
Midwest	1.28	(1.05-1.55)	1.04	(0.85-1.29)
South	1.40	(1.15-1.70)	1.11	(0.91-1.34)
West	1.26	(1.03-1.54)	1.32	(1.08-1.62)

* Ref: Reference group

Figure 1


Rate of Medical Errors in Pediatric Trauma Patients with Chronic Conditions
14
12
10
8
6
4
2
0
Rate of Medical Errors
0
1
2
3
4
5+
Number of Chronic Conditions
N of medical errors per 100 discharges
N of medical errors per 1000 hospital stay days